# NATIFLife Newsletter

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April 2020

A Network of Assistive Technology for an Independent and Functional Life
https://natiflife-project.eu/

Interreg Italia-Malta
UNIONE EUROPEA
EUROPEAN UNION
NATIFLife
Fondo Europeo di Sviluppo Regionale
European Regional Development Fund

## The NATIFLife project in the COVID-19 era

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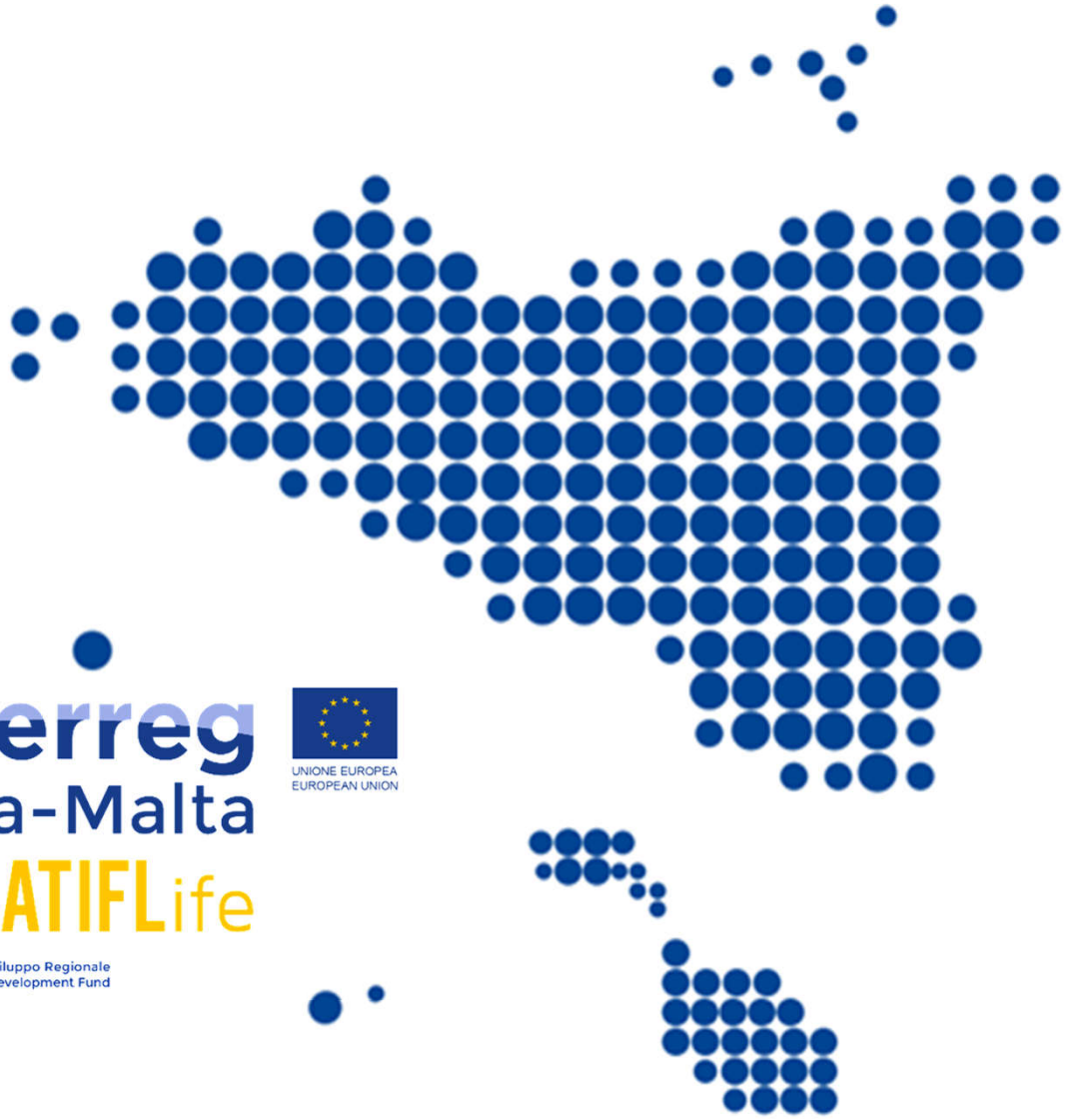

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**The NATIFLife project in the era of the COVID-19 emergency.**

We are almost at the end of this unique adventure, joining amazing research activities as well as fascinating Networking and Communication actions. The last Networking Event, held in January at the University of Catania, Italy, has been really effective. I would personally thank all attendees to the event, with particular regards to entities belonging to the NATIFLife Network.

The NATIFLife project is representing a unique opportunity for All-of-Us to deeply understand challenges and open problems in the field of Assitive Technology.

The current COVID-19 related emergency is further launching new challenges, while confirming the strategic role that Assistive Technology could have for the right management of this kind of situations.

As well known, the NATIFLife project aims at the development of Assistive Technologies to improve the life quality, autonomy and health of elderly living alone, also through remote forms of monitoring and assistance.

This kind of technologies could be really effective, strategic and strongly compliant with actions required to confine dangerous epidemics phenomenon (such as the COVID-19). Such emergencies require people to remain at home, with particular regards to older people. The use of an advanced platform of Assistive Technology, such as the NATIFLife platform, would allow for the remote monitoring of habits and physical status of elderlies, thus guaranteeing the required degree of assistance.

In this sense the NATIFLife consortium is accomplishing last efforts to better understand how solutions developed and integrated into the NATIFLife platform could be optimized or extended to better fit above mentioned needs.

A last challenge for a this very committed group of Researchers and SME, willing to finalize effective solutions to help elderly people living better.

**The project coordinator**
*Prof. Bruno Andò*
*DIEEI-University of Catania, Italy*

## A real need of a growing society!

The ageing of the population is one of the most significant phenomena of the 21st century, which has important and far-reaching consequences for all sectors of society as an increase in the costs for social spending and services related to the aging of the population on an increasingly smaller share of working age people.

With reference to the member countries of the European Union, Eurostat data show how in the decade 2007-2017 the share of over-65 people, compared to the total population, increased by an average of 2.4% for EU countries and represented 19% of EU population in 2017. The percentage of people aged 80 or over is expected to more than double by 2080, accounting for 13% of the total population. The relationship between the number of people over 65 and the number of people of working age (15-64) will increase from 21.6% in 2016 to 51.2% in 2070. The same study estimates that the total cost of ageing related services in EU, is expected to rise from 1.7% of GDP in 2016, to 26.7% in 2070. The most significant contribution to the increase in age-related expenses, according to forecasts, will come precisely from the costs related to health care and long-term care.

The progressive demographic aging represents a series of challenges also in terms of quality of life for the elderly. In fact, one of the main social challenges concerns the possibility of guaranteeing everyone to be able to age with dignity and in safety, with a satisfactory quality of life,. This idea is the basis of the concept of "***Active Aging***", as defined by the World Health Organization: "*Active aging is the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age*". According to this definition, Active Ageing results from the combination of autonomy, independence, quality of life. The ability to take care of oneself, to carry out common ***Activities of Daily Living (ADL)*** independently, to have a socially active life and to stay healthy for as long as possible, are aspects that are gaining more and more importance among the elderly population.
The ability to perform ADLs is used to assess the functional status of people recovering from injuries or affected by chronic diseases or disabilities, and even of elderly. Thus, monitoring ADLs of elderly people can be helpful in improving their quality of life and be beneficial to their caregivers.

In this context, technology can play a strategic role to guarantee the elderly with the possibility to live, as long as possible, an autonomous, independent and healthy life in their own environments, contributing to the improvement of the safety and decentralizing part of the social-assistance activities from healthcare facilities to the users' residences. This represents an enabling step towards implementation of new social assistance models.

According to the definition provided by the WHO, assistive devices and technologies are those whose primary purpose is to maintain or improve an individual's functioning and independence to facilitate participation and to enhance overall well-being. They can also help prevent impairments and secondary health conditions.

The ***NATIFLife*** Project aims to define a ***new infrastructure*** to develop valuable solutions in the field of ***Assistive Technology.***

The general objective of the project is **to improve the quality of life of elderly and people with minor mobility impairments (e.g. at risk of fall)**, addressing their needs of **living autonomously** their domestic environments.

**Specific objectives** are:

**Communication and networking activities**
*Communication* to End-Users, Public Audience and Enterprises: ***info days.***
*Networking activities*: exchange of competences, ToK, Demand/Offer exercise, ***Hands on Training*** *for Enterprises.*


**Developing a flexible integrated platform for assistive technologies**
The *integrated platform* of Assistive Technology will be compliant with traditional and innovative solutions.

**Strengthening of 2 research centers**
The *two research centers* will be complementary reinforced to perform disruptive research in the field *two research centers* of AT and to become *a reference for Enterprises.*


**The realization of two Living Labs in Sicily and Malta**
The *two Living Labs* will allow design and testing innovative Assistive Technology by End-Users; implementing dissemination and training on AT.

## Project PARTNERS

UNIVERSITÀ degli STUDI di CATANIA
L-Università ta' Malta
Comune di Catania
VITECO e-LEARNING SOLUTIONS
SALUPO Innovation Technology
C.T.A. HELIOS
PARAGON EUROPE

## PRESS CAMPAIGN


LIVESICILIACATANIA

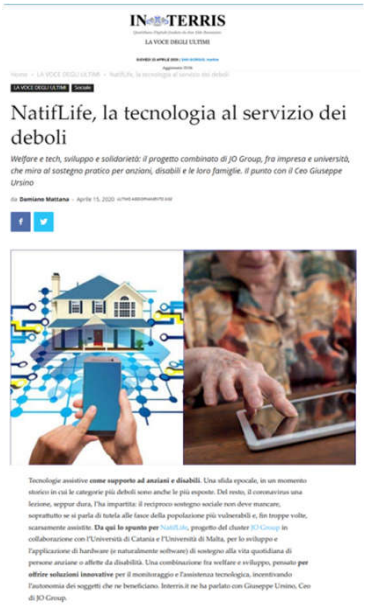
IL PROGETTO NATIFLIFE

Coronavirus e spazi chiusi
Le opportunità della tecnologia

Monitoraggio ambientale e sanitario.

**CATANIA - Consentire agli anziani e alle persone con limitazioni e disabilità, non a caso le più fragili di fronte a emergenze sanitarie come quella legata al Coronavirus, di vivere una vita più sana, indipendente e dignitosa, così incoraggiate a non perdere vitalità.** Questo l'obiettivo, ormai in fase di test finale, del progetto europeo NATIFLife, finalizzato a offrire agli utenti una rete di cosiddette "tecnologie assistive" per una vita indipendente e funzionale che concorra ad una logica di invecchiamento attivo. Un progetto all'avanguardia sul piano

Evitate questi 5 cibi
Questo cibo causa stanchezza e patolog
BodyFokus


IN TERRIS

NatifLife, la tecnologia al servizio dei deboli

*Welfare e tech, sviluppo e solidarietà: il progetto combinato di JO Group, fra impresa e università, che mira al sostegno pratico per anziani, disabili e le loro famiglie. Il punto con il Ceo Giuseppe Ursino*


La Voce dell'Jonio

**Salute / Indipendenza e invecchiamento attivo: da Catania l'innovazione delle "tecnologie assistive" NATIFLife**

The NATIFLIFE project was disseminated through streaming videos available online.


https://youtu.be/TOk35XJVutA

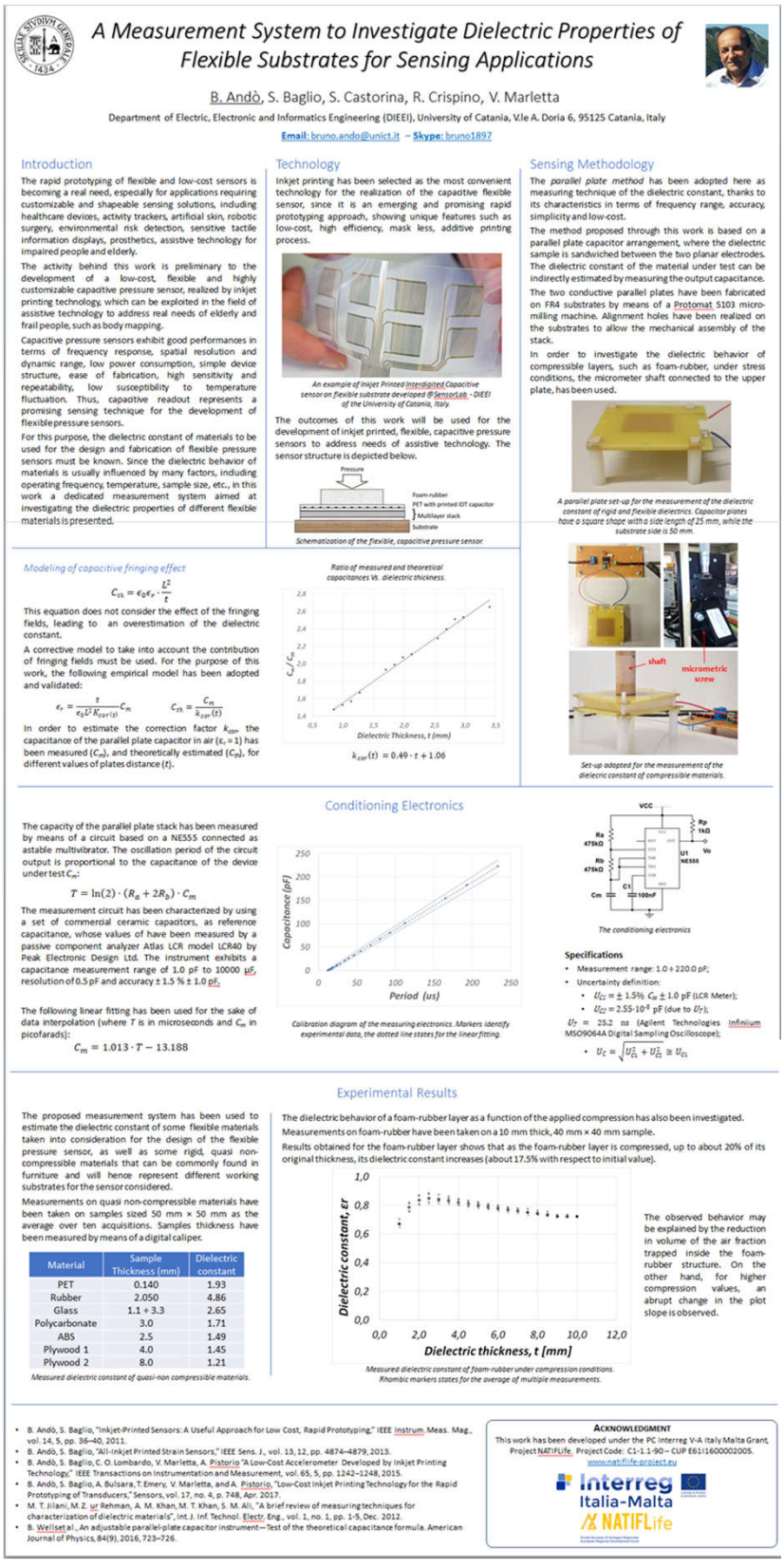

https://youtu.be/TOk35XJVutA

## SCIENTIFIC DISSEMINATION

- **IEEE SAS 2020**

2020 IEEE SENSORS APPLICATIONS SYMPOSIUM
MARCH 9-11, 2020 | KUALA LUMPUR, MALAYSIA

The paper titled "A measurement system to investigate dielectric properties of flexible substrates for sensing applications " has been presented as a poster by the DIEEI of the University of Catania at the 2020 IEEE **International Sensors Application Symposium (SAS)** foreseen in Kuala Lumpur (Malaysia) on March 9-11, 2020.
Due to the COVID-19 emergency, the symposium has been held trough a virtual platform.



*A Measurement System to Investigate Dielectric Properties of Flexible Substrates for Sensing Applications*

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Introduction

The rapid prototyping of flexible and low-cost sensors is becoming a real need, especially for applications requiring customizable and shapeable sensing solutions, including healthcare devices, activity trackers, artificial skin, robotic surgery, environmental risk detection, sensitive tactile information displays, prosthetics, assistive technology for impaired people and elderly.

The activity behind this work is preliminary to the development of a low-cost, flexible and highly customizable capacitive pressure sensor, realized by inkjet printing technology, which can be exploited in the field of assistive technology to address real needs of elderly and frail people, such as body mapping.

Capacitive pressure sensors exhibit good performances in terms of frequency response, spatial resolution and dynamic range, low power consumption, simple device structure, ease of fabrication, high sensitivity and repeatability, low susceptibility to temperature fluctuation. Thus, capacitive readout represents a promising sensing technique for the development of flexible pressure sensors.

For this purpose, the dielectric constant of materials to be used for the design and fabrication of flexible pressure sensors must be known. Since the dielectric behavior of materials is usually influenced by many factors, including operating frequency, temperature, sample size, etc., in this work a dedicated measurement system aimed at investigating the dielectric properties of different flexible materials is presented.

Technology

Inkjet printing has been selected as the most convenient technology for the realization of the capacitive flexible sensor, since it is an emerging and promising rapid prototyping approach, showing unique features such as low-cost, high efficiency, mask less, additive printing process.

An example of Inkjet Printed Interdigited Capacitive sensor on flexible substrate developed @SensorLab - DIEEI of the University of Catania, Italy.

The outcomes of this work will be used for the development of inkjet printed, flexible, capacitive pressure sensors to address needs of assistive technology. The sensor structure is depicted below.

Schematization of the flexible, capacitive pressure sensor.

Sensing Methodology

The *parallel plate method* has been adopted here as measuring technique of the dielectric constant, thanks to its characteristics in terms of frequency range, accuracy, simplicity and low-cost.

The method proposed through this work is based on a parallel plate capacitor arrangement, where the dielectric sample is sandwiched between the two planar electrodes. The dielectric constant of the material under test can be indirectly estimated by measuring the output capacitance.

The two conductive parallel plates have been fabricated on FR4 substrates by means of a Protomat S103 micro-milling machine. Alignment holes have been realized on the substrates to allow the mechanical assembly of the stack.

In order to investigate the dielectric behavior of compressible layers, such as foam-rubber, under stress conditions, the micrometer shaft connected to the upper plate, has been used.

A parallel plate set-up for the measurement of the dielectric constant of rigid and flexible dielectrics. Capacitor plates have a square shape with a side length of 25 mm, while the substrate side is 50 mm.

Set-up adopted for the measurement of the dielectric constant of compressible materials.

*Modeling of capacitive fringing effect*

$$C_{th} = \epsilon_0 \epsilon_r \cdot \frac{L^2}{t}$$

This equation does not consider the effect of the fringing fields, leading to an overestimation of the dielectric constant.

A corrective model to take into account the contribution of fringing fields must be used. For the purpose of this work, the following empirical model has been adopted and validated:

$$\epsilon_r = \frac{t}{\epsilon_0 L^2 K_{corr}(t)} C_m \qquad C_{th} = \frac{C_m}{k_{cor}(t)}$$

In order to estimate the correction factor $k_{corr}$ the capacitance of the parallel plate capacitor in air ($\epsilon_r = 1$) has been measured ($C_m$), and theoretically estimated ($C_{th}$), for different values of plates distance ($t$).

Ratio of measured and theoretical capacitances Vs. dielectric thickness.

$$k_{cor}(t) = 0.49 \cdot t + 1.06$$

Conditioning Electronics

The capacity of the parallel plate stack has been measured by means of a circuit based on a NE555 connected as astable multivibrator. The oscillation period of the circuit output is proportional to the capacitance of the device under test $C_m$:

$$T = \ln(2) \cdot (R_a + 2R_b) \cdot C_m$$

The measurement circuit has been characterized by using a set of commercial ceramic capacitors, as reference capacitance, whose values of have been measured by a passive component analyzer Atlas LCR model LCR40 by Peak Electronic Design Ltd. The instrument exhibits a capacitance measurement range of 1.0 pF to 10000 μF, resolution of 0.5 pF and accuracy ± 1.5 % ± 1.0 pF.

The following linear fitting has been used for the sake of data interpolation (where $T$ is in microseconds and $C_m$ in picofarads):

$$C_m = 1.013 \cdot T - 13.188$$

Calibration diagram of the measuring electronics. Markers identify experimental data, the dotted line states for the linear fitting.

The conditioning electronics

Specifications

- Measurement range: 1.0 ÷ 220.0 pF;
- Uncertainty definition:
  - $U_{C1} = \pm 1.5\%\ C_m \pm 1.0$ pF (LCR Meter);
  - $U_{C2} = 2.55 \cdot 10^{-3}$ pF (due to $U_T$);

$U_T$ = 25.2 ns (Agilent Technologies Infinium MSO9064A Digital Sampling Oscilloscope);

- $U_C = \sqrt{U_{C1}^2 + U_{C2}^2} \cong U_{C1}$

Experimental Results

The proposed measurement system has been used to estimate the dielectric constant of some flexible materials taken into consideration for the design of the flexible pressure sensor, as well as some rigid, quasi non-compressible materials that can be commonly found in furniture and will hence represent different working substrates for the sensor considered.

Measurements on quasi non-compressible materials have been taken on samples sized 50 mm × 50 mm as the average over ten acquisitions. Samples thickness have been measured by means of a digital caliper.

| Material | Sample Thickness (mm) | Dielectric constant |
|---|---|---|
| PET | 0.140 | 1.93 |
| Rubber | 2.050 | 4.86 |
| Glass | 1.1 + 3.3 | 2.65 |
| Polycarbonate | 3.0 | 1.71 |
| ABS | 2.5 | 1.49 |
| Plywood 1 | 4.0 | 1.45 |
| Plywood 2 | 8.0 | 1.21 |

Measured dielectric constant of quasi-non compressible materials.

The dielectric behavior of a foam-rubber layer as a function of the applied compression has also been investigated. Measurements on foam-rubber have been taken on a 10 mm thick, 40 mm × 40 mm sample.

Results obtained for the foam-rubber layer shows that as the foam-rubber layer is compressed, up to about 20% of its original thickness, its dielectric constant increases (about 17.5% with respect to initial value).

Measured dielectric constant of foam-rubber under compression conditions. Rhombic markers states for the average of multiple measurements.

The observed behavior may be explained by the reduction in volume of the air fraction trapped inside the foam-rubber structure. On the other hand, for higher compression values, an abrupt change in the plot slope is observed.


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ACKNOWLEDGMENT
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NATIFLife

## VISITS OF END-USERS AND TECHNOLOGY DEMONSTRATION

Visits of end users to the PDS have been conducted with the aim of demonstrating the technologies installed, giving them the possibility of testing and gain feedbacks and suggestions.
Visits have been suspended due to the COVID-19 emergency.

## The new NATIFLife video

The restrictions imposed to confine the spread of the virus, make not possible to carry out all the activities requiring the presence of groups of people.
Contingency actions have therefore been prepared to provide alternative ways of implementing the activities connected with dissemination, networking, demonstrative sessions of assistive technology for end users.
To this aim, a package of informative multimedia products was prepared and shared among all the partners.
With particular reference to the demos of assistive technology for end users, a demonstration video of the technology installed at Adrano's PDS was prepared.

Demonstrations can be performed by using the VIDEO and the Questionnaire available at the following links:

**https://natiflife-project.eu/quest/ita/index.html** (video italian)

**https://natiflife-project.eu/quest/eng/index.html** (video english)

**https://forms.gle/7PwbpRDdTXX3Vzk86** (questionnaire italian)

or accessing the **NATIFLife Project home page** .

The idea for the implementation of the activity involves viewing the video by potential end users or their relatives, caregivers and, in general, people who can in turn convey the message.

## NATIFLife Network

Join the network at **https://network.natiflife-project.eu** and take the following advantages!

- **Networking**
  Increasing Visibility, exchange of Best Practice among Stakeholders, Demand/Offer of Needs/Technology.
  Developing Joint Research on innovative AT, also through the participation to research projects.

- **Training and Hands-On Sessions on Assistive Technology and User Centered Design.**

- **Sharing R&D Labs Facilities**
  Sharing facilities and equipment to develop joint activities of industrial interest: Rapid Prototyping of wearable and flexible sensors, Smart Sensing Embedded Systems, Robotic platforms.

- **Exploiting Living Labs**
  Assessment of Assistive Technologies by End-Users involvement.

Join the groups that best fits your interests:

- **The NATIFLife Network**: for all the participants to the network
- **Researchers & Technicians**: dedicated to whom is interested in the technical aspects of the assistive technologies, both traditional and innovative, being developed within the project.

## Training and Hands-on Activity for the NATIFLIFE Network

The project partners and the members of the network participated to training sessions and hands-on activities held on January 29th 2020 at the Department of Electric Electronic and Information Engineering (DIEEI) of the University of Catania. Participants have gained training on technical aspects and had the possibility to visit the research lab hosting the facilities acquired during the project and test the solutions under developing.


# Bringing new equipment at the University of Malta

The University of Malta has worked on the use of a non-invasive technique that uses the depth information obtained through active stereo image sensors to localize, monitor and support the elderly while performing daily routines in typical houses. To support this activity, 20 active stereo cameras and 10 3D video cameras were purchased together with a high performing computing machine to work out the computations necessary for localization of people within the field of view of the cameras and monitor them. Moreover, the monitoring capability was enhanced through the purchase of body sensors, vital monitoring sensors, and wireless sensor nodes. These wearable sensors monitor the movement and vital signals of the person and can be used to augment the information obtained through the camera system. A server was also purchased to gather all the data coming from the different sensors and perform the necessary computations. Finally, mobile devices and tablets, having either iOS or Android operating system, were obtained to develop and test applications on the different platforms and technologies. With the new equipment the laboratories within the Faculty of ICT at the University of Malta will offer researchers the possibility to do research work using more modern sensing devices and stakeholders to view how modern technology can be applied in supporting active aging at home.

Stereo cameras and computer


Zephyr Echo Repeater

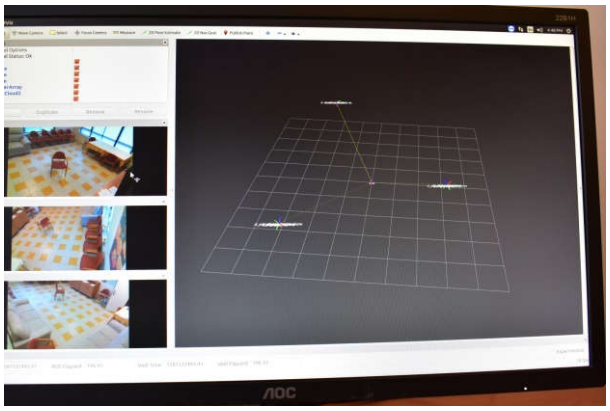
Body sensor nodes

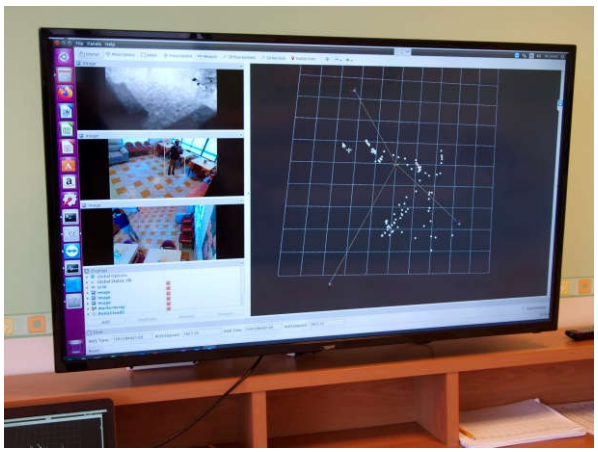

Three last generation mobile phones

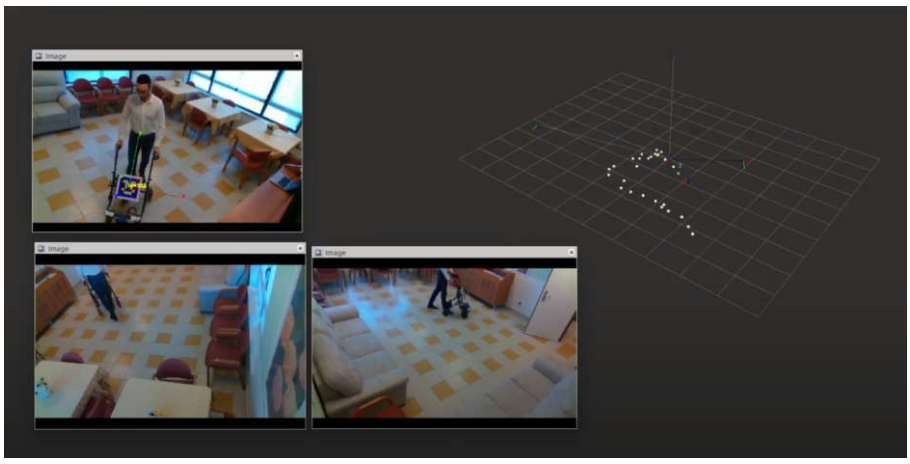
## Depth cameras based localization system at the PDS in Adrano

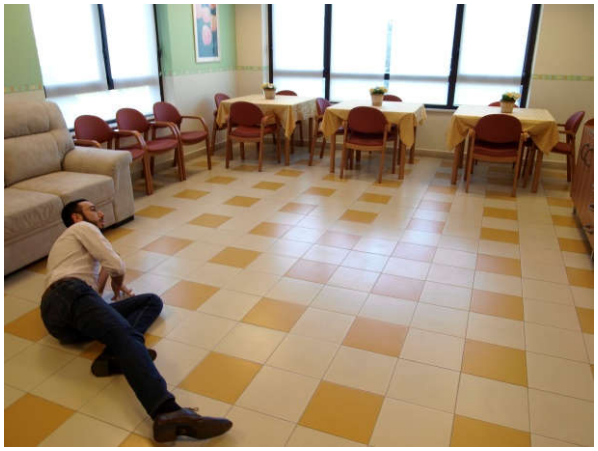
Updates to the Depth cameras based system installed in the living room of the PDS in Adrano (Catania) and to the software have been made in February 2020 by the researchers of the University of Malta.

Cameras will be used for the sake of user-environment interaction monitoring and fall detection.










(a) One of the depth cameras installed in the PDS; (b) the GUI showing the field of view of the cameras and the reference system; (c, d) the GUI and the localization of the user w/o the walker moving in the room; (d, e) a user simulating a fall evet and the notification on the GUI.

## Join the NATIFLife Network!

*Explore your own advantages*

**www.natiflife-project.eu**

## Join the NATIFLife Network on the social

https://www.facebook.com/NATIFLifeProject/

https://www.linkedin.com/groups/8680941

For information contact us at: **info@natiflife-project.eu**